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THE INDIAN SPECIES OF THE GENUS
CARALLUMA (FAM. ASCLEPIADACEAE)

BY
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The genus *Caralluma* presents great difficulties to the herbarium worker as certain important characters, easily recognizable in fresh material, are most difficult to see clearly in dry. Though an admirable revision of the genus as a whole was given by Berger in 1910 in his "Stapeliaceen und Kleinien", his treatment of the Indian species needs supplementing with observations made locally; and it is evident from the herbarium sheets we have examined that the identifications they bear, and consequently the published locality records based upon them, are by no means always correct. Our thanks are due to Prof. Barnes of Madras, Prof. Kashyap of Lahore and Fr. Blatter of Bombay for specimens they have sent us; to the directors and staff of the Botanic Gardens at Kew (particularly Mr. Fischer and Mr. Brown), and at Calcutta and of the Agricultural Research Institute at Coimbatore, for facilities to examine their herbaria and for other help; to Dr. J. Burt Davy for his search for the type of *C. umbellata* at Oxford; and to Mr. Venkateshaya of Tirupati for checking the Telugu names.

The genus *Caralluma* was first separated from the older genus *Stapelia* by Robert Brown in a paper read in 1809. In 1834 Wight and Arnott established the genus *Bouce-rosia* for *Caralluma umbellata* and *C. crenulata* and the genus *Hutchinia* for a new species which they described under the name *indica*. The genera *Apteranthes*, *Desmidorchis*, and *Quaqua*, which are also given by Berger as synonyms of *Caralluma*, do not appear to contain any Indian species. In 1890 N. E. Brown introduced sweeping reductions among the genera of *Stapeliaceae*. He says (pp. 2-4) "And now after a study of many years—during which a very large number of specimens, amounting to some hundreds, living, dried, and preserved in alcohol, have passed through my hands—I am quite unable to find any definite limiting characters for some of the genera here [*i.e.* in Haworth's "Synopsis" of 1821 and "Supplementum" of 1819] retained. The genera have been chiefly founded upon the structure of the corona, shape of the corolla, and habit of the plant. Habit, we know, is often a fallacious character, as, for example, in *Veronica* we have annual and perennial herbs, and evergreen shrubs; *Oxalis* and *Pelargonium*, annuals, bulbs, shrubs; in *Euphorbia*, leafy herbs and shrubs, and leafless succulents of very diverse habit; and among *Stapeliaceae* habit appears of no more generic importance than in the genera named. It is true that a similarity of habit prevails among many of the species having the same floral structure, and so forming a distinctive group, but such habit is not invariably limited to those species . . . It is evident, then, that no definite generic character is to be found in the stems. The corolla varies considerably among the different members of the same genus; in *Stapelia* itself it is usually flat and rotate, but some species have a saucer-shaped or shortly campanulate tube, without any alteration in the general coronal structure. With

regard to the coronal structure, that appears to me so indefinitely variable that it cannot, when taken alone, be implicitly relied upon for generic distinction . . . It would be easy to give other instances, but these will suffice to show that, except in a few of the genera, no character, or in some instances even no set of characters, can be relied upon as definitely separating the genera. They all seem to blend and intermingle in a manner that in many cases defies classification.

"I believe this intermingling of characters has been brought about in this way: the *Asclepiadaceae* all require the agency of insects to bring about fertilization; and two species growing within a moderate distance of each other would become very liable to be cross-fertilized with each other's pollen, and hybrids would be likely to result, which would not necessarily be found in the neighbourhood of their parents, as the seeds being provided with a large tuft of long fine hairs, would be liable to be carried to a considerable distance by the wind, in the same way as thistle seeds are carried, and the new hybrid established in another place, where it in turn, in course of time, might give rise to other hybrids. That such has been the origin of many of the species is a conclusion that inevitably forces itself on the mind when such species as *S. Barklyi*, *S. lutea*, *S. intermedia*, etc., are examined and compared with other forms. For these reasons I am in favour of uniting most of the forms under the two genera *Stapelia* and *Caralluma*, which, although containing (in the sense that I understand these genera) a heterogeneous assemblage of species in each case, yet in most cases are seen to be bound together by evident relationship with one another, when all the species, described and undescribed (of which there are many), are passed in review. These two genera certainly have a tendency to merge into each other, but seem to have this distinction: in *Stapelia* the segments of the outer corona are free to the base, whilst in *Caralluma* they are more or less connate with each other, or adnate by their edges to the segments of the inner corona, so as to form a cup-shaped outer corona. If the various forms be not so grouped under these two genera, then a large number of small and often monotypic genera would have to be made, especially if the coronal structure is made the basis of classification as hitherto, and taking each variation as of equal generic value. Such genera would be very unnatural, and would be rather a hindrance than an aid to the student who wished to determine his plants; hence I have only retained as genera those groups of species which seem connected with each other by natural bonds, although often diverse in appearance. Yet, in spite of having thus limited the genera to few, rather than increase their number, I am of opinion that some of the genera still retained are more artificial than natural; for instance, *Frerea*¹, and *Trichocaulon* only differ from *Caralluma* in habit, and *Trichocaulon* only differs from *Hoodia* in its corolla . . . "

The genera retained by Brown were accepted without any addition or reduction by Schumann in 1895 in his account of the *Asclepiadaceae* in Engler and Prantl's "Pflanzenfamilien". But whereas Brown takes the structure of the corona as the basis of his

¹ An exclusively Indian genus, known from a single species, apparently rare, from the Bombay Presidency. It seems to differ from *Caralluma* only in having persistent leaves about an inch long.

primary grouping, giving only secondary importance to habit, Schumann bases his primary grouping on the latter and treats the former as of secondary importance. Schumann also subdivides some of the genera, among them *Caralluma*, into several sections, a plan which has been further developed by Berger in his monograph on the *Stapeliae* published in 1910.

It often happens that when a large and difficult group like the *Stapeliae* is known only from such isolated specimens as first reach Europe a number of species and even genera are described which are proved by further knowledge to be invalid. In such cases the first step towards a natural classification is necessarily the reunion of various small groups into larger and more inclusive genera such as those adopted by Brown. We cannot help expecting, however, that a natural grouping of the species included in these unwieldy genera may eventually be reached, perhaps along the lines suggested by Schumann and by Berger. Our experience has been confined to Indian forms and is thus extremely limited. But the natural classification of these seems so evident, now that we have made a fairly exhaustive study of them, that we hope our presentation of it may help to clear this one small area of the field from confusion.

The characters on which our classification of the Indian forms is based have been selected not on account of any intrinsic importance that, taken by themselves, they may seem to possess; but simply because they seemed to be the best available for the purpose. And these characters prove to have different values in different cases. Thus of two specimens growing side by side under identical conditions and each of them covering a large area, the plants present a striking contrast one with another when the branches of one have the leaf-scars mounted on strongly marked protuberances, often with the leaves persisting for a relatively long period, and the branches of another have no such protuberances nor any trace of leaves; and the natural inference would be that they belong to different species. When, however, they flower they will prove, as likely as not, to belong to a single species while other plants, identical with each other in these respects, may prove to belong to different ones. And, as the former type of plant commonly flowers much more freely than the latter, the form of its stems presumably indicates a physiological difference, evidently in some cases at least of a very persistent, if not actually an innate, type. When, on the other hand, we find that the acuteness or roundness of the stems, characters in themselves of no greater apparent significance than those just mentioned, are definitely associated with other characters common to a particular group of species, or are characteristic of plants found in a particular region, we consider that they should be regarded as having definite taxonomic value. Proceeding on these lines we have found the distribution of hairs on the petals to have considerable taxonomic importance in some species and little or none in others.

Our observations on Indian species further lead us to doubt the correctness of Brown's suggestion that new species are commonly produced by hybridization and that such hybrids would not necessarily be found in the neighbourhood of their parents. We have only met two or three possible types of such hybridization, and these between more

or less closely allied forms which are found in the same locality as the presumed hybrids¹. *Caralluma attenuata* and *C. stalagmifera* are both distributed over the greater part of Southern India; but with the possible exception of three plants from Pudukkottai and Tiruppattur (Ramnad District) we have never found any combining the characters of these two species, nor does either of them appear to hybridize with any of the more distantly related species of the subgenus *Boucerosia* from the same localities. *C. stalagmifera* attracts a particular species of fly which we have never noticed on any other species, a circumstance which no doubt helps to keep it distinct.

The following species, now included in the genus *Caralluma*, have been described from India, Burma and Ceylon² :—

- 1795. *Stapelia adscendens*, Roxburgh, from "high, dry, barren ground" (Coromandel Plants).
- 1812. *Caralluma umbellata*, Haworth, from India.
- 1830. *Caralluma crenulata*, Wallich, from Segain on the Irrawady (opposite Ava).
Caralluma fimbriata, Wallich, from Yenangeun and Pagamew in Burma.
- 1834. *Boucerosia pauciflora*, Wight Mss. (Wight & Arnott, 1834, fig. only; Decaisne, 1844, description). Wight's specimens in the herbarium at Kew are from Palamcottah.
Hutchinia indica, Wight & Arnott, from the Indian Peninsula.
- 1844. *Boucerosia Hutchinia*³, Decaisne, new name for *Hutchinia indica*, Wight & Arnott.
- 1850. *Boucerosia campanulata*, Wight, from unknown locality, identified by Hooker in 1893 with a species from Ceylon.
Boucerosia diffusa, Wight, from near Coimbatore.
Boucerosia lasiantha, Wight, from the Nuggur Hills near Madras.
Caralluma attenuata, Wight, from the foot of the Nilgiris.
- 1862. *Boucerosia edulis*, Edgeworth, from Multan and Sindh.
- 1879. *Boucerosia Stocksiana*, Boissier, from Baluchistan.
- 1885. *Boucerosia ancheriana*, Hooker (*nec* Decaisne) = *B. tuberculata*, Brown, 1892.
- 1892. *Caralluma tuberculata*, Brown, from the Punjab and Baluchistan.
- 1921. *Boucerosia truncato-coronata*, Sedgwick, from Hubli, Dharwar District.
- 1925. *Caralluma stalagmifera*, Fischer, from Vandalur near Madras.

¹ See below pp. 12 & 15.

² We have been unable to trace *Stapelia callamulia*, Hamilton, referred to by Hooker (1875, p. 77) as a synonym of *Boucerosia umbellata*. Mr. Fischer, who has been good enough to make a careful search at Kew, was unable to find any other published reference but was able to give us the following information—"I found on one sheet in the collection of prints the word Cullumoloyan, both in English and Tamil. It was a drawing of *Boucerosia umbellata*, but whose drawing there is nothing to show. It is evidently the Tamil name."

³ Hooker (1885, p. 78) uses the same name for this species, but misspells it *Hitchinia*.

Following Schumann, Berger divides the genus *Caralluma* into three sections, *Eucaralluma* (= *Caralluma*, s. str.), *Lalacruma* and *Boucerosia*, of which only the first and last are Indian, the second being confined so far as is known to East Africa, and differing from the first only in having a pedunculate gynostegium.

Caralluma, s. str., and *Boucerosia* can easily be distinguished, at least so far as Indian forms are concerned, by the arrangement of the flowers and by the nature of the stems. In *Caralluma*, s. str., the flowers arise in (or more usually close beside) the axils of the rudimentary and evanescent leaves all along the distal portion of the stem; in *Boucerosia* the flowers are either terminal (usually in compact umbels though sometimes solitary) or, in the single species known from Baluchistan, the Punjab, etc., in compact umbels arising in leaf axils but not in series, always isolated. In *Caralluma*, s. str., the stems are almost always more or less distinctly tapered distally, usually very markedly so, at least when fully matured; in *Boucerosia* the stems are of approximately uniform thickness throughout.

Young shoots of *Caralluma*, s. str., though very bitter, are commonly eaten raw in South India. The larger forms of *Boucerosia* do not seem to be eaten at all except by the Oddans of Coimbatore and Salem districts, who first cook them. But, among the smaller forms distinguished below as the *indica* group, the only two which we have found wild—*B. indica* and *B. pauciflora*—are particularly liked, for instead of being bitter they are pleasantly acid to the taste.

The general Tamil name for the genus as a whole in the Coimbatore, Salem, Arcot and Chingleput districts associates it with the common succulent *Euphorbia* (Tamil, *kalli*) and may be taken to mean either "that which resembles a *Euphorbia* shoot" or "that which lives among *Euphorbia* and thorns" according as it is rendered *kallimulaiyan*¹ or *kallimulliyān*². In Shankaridrug in the Salem District, however, the name *kilivan* is used—possibly a corrupted form of the usual one—*Boucerosia* of the *umbellata* group being distinguished as *oddan kilivan*³ on account of its being eaten, as already noted, only by the Oddan caste. Further south these names are replaced by *eluman*⁴ (= young deer) in Pudukkottai and the surrounding districts and by *siruman*⁵ (= small deer) in Palni, Dindigul and Madura in the Madura District and Papanasam and Tenkasi in the Tinnevely District. Eating the plant is said to give the agility of such animals, but whether the name originated in the belief, or the belief in the name, we cannot say. The latter is perhaps the more probable, in which case the name may conceivably have originated from a fancied resemblance between pieces of the plant and the horns of a deer. In Tiruppattur, Ramnad District, the plant seems to be regarded as a sour form of *Vitis quadrangularis* or *pirandai*, being referred to simply as *puliyam pirandai*⁶. The general name used in Pollachi and at the foot of the Anamalai

¹ கள்ளிமுளையான்.

² கள்ளிமுள்வரியான்.

³ ஒட்டன் கிளிவான்.

⁴ எலுமான்.

⁵ சிறுமான்.

⁶ புளியம்பிரண்டை.

⁷ மலை இஞ்சுவான்.

Hills is *iluvan*, large coarse inedible forms being distinguished as *malai* (hill) *iluvan*⁷ while those eaten are called *pulichan*¹ (sour thing). In Thakalai in South Travancore the association with *Euphorbia* reappears, the name used being *paraikalli*⁸ or "rock *Euphorbia*." Only large inedible forms seem to occur there. The usual name in South Travancore and the neighbouring parts of Tinnevely (e.g. Kalakad) is *kallukutainchan* or "that which pierces the rock." *Caralluma*, *s. str.* is distinguished as *chinna* (small) *kallukutainchan*⁹, *C. (B) procumbens* as *periya* (big) *kallukutainchan*⁴ and *C. (B)? umbellata* (no fully developed flowers seen) as *peyi* (devil) *kallukutainchan*⁵.

The *umbellata* and *indica* groups of *Boucerosia* are distinguished from *Caralluma*, *s. str.*, by prefixing the name of an animal, or more rarely an adjective, suggesting large or small size. Thus in the Coimbatore, Salem, Arcot, and Chingleput districts the prefix *erumai*⁶ (= buffalo) and in Madura, Pudukkottai, etc., the prefix *madd*⁷ (= cow) are used to distinguish the larger *Boucerosia* (*umbellata* group) from the true *Caralluma*, the smaller ones (*indica* group) being distinguished by the prefix *koli*⁸ (= fowl) in Madura and *chitt*⁹ (= small) or *musal*¹⁰ (= hare) in Pudukkottai and the neighbouring districts. In Madura *Caralluma*, *s. str.*, is distinguished as *panri*¹¹ (= pig) *eluman*. Elsewhere the group name without any prefix is used in a more special sense to indicate this subgenus.

The general Telugu name for *Caralluma*, *s. lat.*, is *kundeti* or colloquially *kundelu* (= hare), *chevi* (= ear) or *chevulu* (= ears) or *kommu* (= horn) or *kommulu* (= horns)¹² presumably on account of the form of the seed pods. Members of the *indica* group are, however, usually distinguished as *eluka chevulu*¹³ or rat's ears, doubtless on account of their small size. In the Anantapur District the name *kalabanda*¹⁴ is the name most commonly used, though elsewhere it seems to be confined to aloes and agaves. It means literally "a dweller among rocks".

At Hospet in the Bellary District the Kanarese were found to combine the Kanarese word *huli* with the Telugu word *chinta*, both meaning tamarind, and to use the resulting *hulichinta*¹⁵ for *Caralluma*, apparently restricting it to *Caralluma*, *s. str.*, though *Boucerosia umbellata* also grows there.

At Palghat, where only *Caralluma*, *s. str.*, is known, it is called in Malayalam *pulicha* (sour) *thunda* (stick)¹⁶.

¹ புளிச்சான்.

² பாலைக்கள்ளி.

³ சின்ன கல்லுக்குடைஞ்சான்.

⁴ பெரிய கல்லுக்குடைஞ்சான்.

⁵ பேய்க்கல்லுக்குடைஞ்சான்.

⁶ எருமை எருமான்.

⁷ மாட்டெருமான்.

⁸ கோழி எருமான்.

⁹ சிற்பெருமான்.

¹⁰ முசுலெருமான்.

¹¹ பன்றி எருமான்.

¹² కుండే (or కుండే) చెవి or చెవులు or కొమ్మ or కొమ్మలు.

¹³ ఎலక చెవులు.

¹⁵ కుళిచింత.

¹⁴ కలబండ్.

¹⁶ പുളിച്ചുതണ്ട.

Subgenus *Caralluma*, Brown, *s. str.* = *Eucaralluma*, Schumann.

Type, *Stapelia adscendens*, Roxburgh.

This subgenus contains a comparatively small number of species confined, so far as is at present known, to an area extending from Nubia in the west to Burma in the east. They usually grow, in South India at least, mixed with other vegetation, such as prickly pear, tufts of coarse grass or scrub jungle.

Six species of *Caralluma*, *s. str.*, have been described from India: two, which are now recognized as identical, from the Punjab, Sind and Baluchistan, and the rest from the Peninsula, one of these extending to Ceylon and Burma. We have no specimens of the north-western species, for which the name *edulis*, Edgeworth, has precedence over *Stocksiana*, Boissier; but from Edgeworth's description and figures we conclude that it differs from the Peninsula species, all of which we have, in the form of the outer lobes of the corona, the longitudinal striation of the bases of the petals, the absence of a spine-like process at the apex of the petals and the larger size of its (? more persistent) leaves. It seems likely, therefore, that the Peninsula species form a natural group by themselves. This is confirmed by the fact that a group of new forms from the far south of the Peninsula, though differing from the rest in that the angles of their stems are acute instead of rounded, agree with them, and especially with *C. attenuata*, in the structure of the flower. *C. attenuata* is a widely distributed and somewhat variable form, and as these new forms, of which we must recognize at least three, differ from it quite as much as do *C. fimbriata* and (apart from its hairless flowers) even *C. adscendens*, it will be necessary either to describe them as new species or to rank *C. fimbriata* and *C. adscendens* along with them as varieties of a single species for which the name *adscendens* would have priority. It is possible that the former course may ultimately prove to be right, especially as we have evidence that at least one of the new forms breeds true. But we feel that it is best to adopt the latter course for the present.

We may then recognize the following Indian species:—

1. Outer lobes of corona distinct, 10 in number, their filamentous apices widely separated throughout (North-Western species) *C. edulis*, p. 8.
- Adjacent pairs of outer lobes of corona fused to form plates, from the distal end of each of which arises a pair of long terminal filaments, almost in contact with one another at base (Peninsula species; also Ceylon and Burma) 2
2. Basal parts of petals expanded, greenish or yellowish with transverse purplish striations, distal parts (except for the apical process) dark purplish, folded back along the middle line; hairs filamentous, spindle-shaped or absent *C. adscendens*, p. 8.

- Petals expanded and almost always dark purplish throughout (except for the apical process); hairs strongly spindle- or club-shaped, confined to the margins of the petals and often to the apex, readily detached ... *C. stalagmifera*, p. 16.

Caralluma edulis (Edgeworth).

Pl. I figs. 1-3.

Boucerosia edulis, Edgeworth, 1852, p. 205, pl. I, figs. 1-8.

Boucerosia Stocksiana, Boissier, 1879, p. 64.

Caralluma edulis, Cook, 1903, p. 179.

Caralluma edulis, Berger, 1910, p. 51.

As we have no specimens of this species our figures have had to be copied from those given by Edgeworth. It is recorded, as already noted, only from the north-western parts of India—the Punjab, Baluchistan and Sind (Jemadarka Landa and Mulir, both near Karachi). The angles of the stem are rounded, the leaves appear from the figure to be unusually large and persistent as compared with those of other Indian species of the genus, the flowers arise in pairs from the axils of the leaves and are borne on long slender subpendulous pedicels (in the figure they appear to be erect), the base of the corolla is streaked (the figure suggests longitudinally) with purple, the petals are without hair and apparently also without any distinct apical process.

Edgeworth's description is as follows:—Rhizoma stolonosum, crassum, ramis radicanibus, radicibus fibrosis. Rami erecti, succulenti, subteretes, 4-sulcati. Folia opposita, cuneata v. elliptica, caduca. Pedicelli gemini, alares, graciles, subpenduli, demum erecti, bibracteati, bracteis subulatis minutis. Calyx 5-partitus, segmentis acutis pellucido-marginatis. Corolla 5-fida, utrinque glabra, venacea, basi purpureo-striata tubo inflato hemisphærico, laciniis subulatis attenuatis reflexis. Corona 15-fida, segmentis 5 ligulatis in antheris incumbentibus, 10 intermediis brevioribus falcato-subulatis intus cavis purpurascens nectariferis. Pollinia gibba, apice pellucida. Folliculi erecti, teretes, laevissimi, glaberrimi, valde attenuati. Semina marginata, alata, longe comosa.

"*Edulis*, subacida, sponte in Salvadoretis crescit, ibi colligenda in foro venditur sub nomine *Situn*."

Caralluma adscendens (Roxburgh).

Pl. I-III.

Stapelia ahsentens, Roxburgh, 1795, pp. 28-29, pl. 30.

Caralluma fimbriata, Wallich, 1830, p. 7, pl. vii.

Caralluma fimbriata, Loddiges, 1832, No. 1863 (fig).

Caralluma attenuata, Wight, 1850, pl. 1268.

Caralluma attenuata, Thwaites, 1864, p. 200.

Caralluma adscendens + *attenuata* + *fimbriata*, Hooker, 1885, pp. 76-77.

Caralluma fimbriata, Cook, 1908, pp. 179, 180.

Caralluma adscendens + *attenuata* + *fimbriata*, Berger, 1910, pp. 50-51 and 54-55, figs. 11, 1-3.

In this variable and widely distributed species at least six distinct forms have to be recognized, as already indicated above (p. 7). The characters by which they are separated are found partly in the flower and partly in the stem. In the three varieties *adscendens*, *s. str.*, *attenuata*, and *fimbriata*, that have long been known and have hitherto been regarded as distinct species, the stem is squarish in section with the sides usually slightly hollowed and the angles always rounded, never acute as they are represented in Roxburgh's figure of the first (1795, pl. 30)¹, and Wight's figure of the second (1850, pl. 1268); and we have been unable to find any acute-angled forms north of a line from the State of Pudukkottai to Neringipet in the Coimbatore District. That the artists who prepared the original figures of them should have thus intensified the marked angularity of their stems is very natural; but it is a most unfortunate mistake in view of the discovery, during the preparation of this paper, of a group of varieties apparently confined to the extreme south of the Indian Peninsula, which is distinguished from them by this very character. This group with acute-angled stems has been found in the districts of Pudukkottai, Ramnad, Coimbatore, Madura and Tinnevely, the first three and each of the two last of which has its own characteristic variety, making three varieties in all.

The stems (apart from their acute angles) but not the flowers of the first variety, and the flowers but not as a rule the stems of the second variety, are not unlike those of var. *attenuata*. The flowers of the first and third varieties resemble each other more closely than they do those of *C. stalagmifera* or *C. adscendens* vars. *attenuata* and *fimbriata*. It is therefore impossible to suggest any cross that would seem likely to produce any of these acute-angled varieties. That they are not hybrids is further indicated by the results we have obtained on raising the second variety from seed. Seed from a pod collected in the Alagar Hills was sown in Madras. Several plants grew large enough to flower and all came absolutely true to type. Later another plant was raised from seed, apparently self-sown, in Madras. This, too, came absolutely true to type. It seems most unlikely that these plants would not have shown considerable variation had they come of hybrid stock.

Hybridization does, however, appear to take place between var. *attenuata* and the only acute-angled variety that grows with or near it, and possibly also between the latter variety and *stalagmifera*, which likewise occurs with it. Such hybrids have only been found in the localities inhabited by their parents (see below, pp. 12 & 15).

The six varieties may be defined as follows:—

1. Flowers hairless; leaf scars (particularly on old stems)
on blunt, rather prominent, outwardly directed pro-
tuberances var. *adscendens*, *s. str.*

¹ A somewhat acute-angled form of the hairless flowered *adscendens* does, however, occur in the Attapadi Valley, South Malabar.

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- Flowers hairy ; protuberances less distinct, directed more upwards 2
 - 2. Angles of stem, at least towards base, rounded 3
 - Angles of stem, at least towards base, acute 4
 - 3. Stems small and of about equal thickness throughout ... var. *fimbriata*.
 - Stems larger, more or less strongly attenuate distally ... var. *attenuata*¹.
 - 4. Flowers small, on long erect slender pedicels, stems distally very slender, often branched var. *gracilis*².
 - Flowers larger, pendulous or erect ; stems distally as a rule unbranched and much less slender 5
 - 5. Flower usually more or less distinctly pendulous, rarely suberect, their pedicels never bent at an angle, hairs strongly developed ; stems more or less distinctly attenuate, occasionally much branched var. *carinata*.
 - Flowers brought to face upwards by means of a somewhat abrupt bend in their pedicels ; hairs not strongly developed ; stems not markedly attenuate, never branched³ var. *geniculata*.

Caralluma adscendens, s. lat., probably occurs in suitable situations all over the Indian Peninsula south and inclusive of Poona in the west and Ganjam in the east. It also occurs in Ceylon and Burma. Vars. *adscendens*, s. str., and *fimbriata* differ from all the other varieties in that their geographical range is very wide and markedly discontinuous, and in combining two obviously ancestral characters—rounded angles and not markedly attenuate distal region—in the stem. These features lead us to regard these two varieties as the oldest forms of the species ; and of them we regard *fimbriata* as the oldest of all since it is the only form of *Caralluma*, s. str., found in the outlying countries of Burma and Ceylon. The characters both of the stems and of the flowers tend to confirm this conclusion. Its flowers resemble those of *attenuata*, the dominant variety of the Indian Peninsula, which has presumably been derived, either from it or from some closely allied form ancestral to them both, by the development of attenuate terminations to the stems, *adscendens*, s. str., having been derived by the loss of hair from the flowers and by less marked changes in the stems. *Attenuata* has established itself in suitable localities, roughly from the Kistna basin in the north to Coimbatore and Pudukkottai in the south, but has not entirely ousted *fimbriata*, which occurs in several places within this area—

¹ Or the presumed hybrid between this variety and var. *gracilis* (see below, p. 15).

² Or one of its two presumed hybrids (see below, p. 15)

³ Except when well marked secondary growth has taken place. Such growths, which may be found terminating certain branches of otherwise normal plants, are abruptly attenuated from their base, and their flowers lack the characteristic bend in the pedicel.

apparently, however, on its borders only, both western and eastern. *Adscendens*, s. str., has established itself north of the Godavari, where it is the only form of the species found. That it once had a much wider range is, however, indicated by the fact that it is also abundant near Agali in the dry region of the Attapadi Valley, South Malabar, where no other form of *Caralluma*, s. str., seems to have established itself, and that a few plants have been found associated with the locally more abundant var. *carinata* and *C. stalagmifera* on the Nagamalai Hills near Madura.

The acute-angled varieties, which together occupy the far south of the Indian Peninsula, have presumably been derived either direct from the ancestral var. *fimbriata* or from var. *attenuata*. Apart from its acute angles var. *gracilis* closely resembles var. *attenuata* in general habit, while var. *geniculata* (apart from the slender secondary growth which sometimes occurs) resembles rather var. *fimbriata*, var. *carinata* being in this respect transitional between the other two, and unlike them retaining the ancestral pendulous flower.

Var. *gracilis* is the only one of these varieties which is commonly found living in close association with any other variety, having been found in about equal abundance with var. *attenuata* at Neringipet and near Bhavani in the Coimbatore District and at Shankaridrug in the Salem District. In Pudukkottai State the southern limit of distribution of var. *attenuata* appears to be a few miles north of the northern limit of that of var. *gracilis*. In some of these places intermediate forms occur. In Pudukkottai, where both the typical variety and the intermediates were first found, the latter only occur close to the northern limit of distribution of the typical variety—i.e., only a few miles from localities where var. *attenuata* is found—and there they are much less abundant than the typical var. *gracilis*. Near Bhavani the intermediate and two typical forms were found in about equal abundance; but in Neringipet and Shankaridrug, though both the typical forms are common, no intermediates whatever seem to occur.

The three acute-angled varieties, occupying as they do a single geographical area, must presumably have had a common origin, whether through var. *gracilis* from var. *attenuata* or direct from var. *fimbriata*. On the latter hypothesis the intermediates between the two former varieties could only be regarded as hybrids, and their absence from Neringipet and Shankaridrug could be explained if the strains of the parent varieties in those localities happened not to be mutually fertile. On the former hypothesis the intermediates might either be hybrids between two fully differentiated varieties or they might be remnants, which had already disappeared in some places, of the stages through which var. *gracilis* passed in the course of its evolution from var. *attenuata*. At first sight the last may seem the probable explanation, especially when the close similarity between the two varieties is remembered. But when the two other acute-angled varieties are also considered it seems more doubtful, unless the loss of the bend in the pedicels on the slender secondary growths of var. *geniculata* can be taken to indicate that these growths are reversionary.

If, however, the intermediates are hybrids they constitute the only such case of hybridization between two varieties of *adscendens* that we know of. In this connection we must point out that there is some independent evidence suggesting that var. *gracilis* has unusual powers of hybridization, for both in the Pudukkottai Town forests and in Tiruppattur (Ramnad District) where it is found in close association with *C. stalagmifera*, intermediates with this species have also been found which we presume must be hybrids. Yet no apparent hybrid has been found between var. *attenuata* and *C. stalagmifera* over the whole of the immense tract of country where they occur together elsewhere.

A glance of figs. 1-6 of pl. III will show how completely not only *C. adscendens*, vars. *attenuata* and *gracilis* but also *C. stalagmifera* grade into one another in Pudukkottai, where all the specimens there figured were found. This may seem to suggest that there is no true distinction between them. It must, however, be remembered that most of these transitional forms are exceptional, having been carefully selected from among much larger numbers of others and only having been found at all in Pudukkottai. Only in the case of *C. adscendens*, vars. *attenuata* and *gracilis* are transitional forms anywhere common; and except in one locality (near Bhavani) they seem always to be less common than the typical forms, and sometimes are not to be found at all in places where both the typical forms are abundant.

Vars. *adscendens*, *s. str.*, and *fimbriata*, especially the latter, have restricted flowering seasons. In Madras the latter flowers freely during and shortly after the heavy November rains and more sparingly on into the hot weather. The former flowers freely in the hot weather (April-May) and sometimes sparingly at other times. The other varieties flower under suitable conditions more or less continuously throughout the year, as does *C. stalagmifera* also.

Var. *adscendens* (Roxburgh), *s. str.*

Pl. II fig. 1.

Stems often with reddish streaks, not to any great extent attenuate, their angles rounded except sometimes in the Attapadi Valley, where they tend to be more acute; leaf-scars raised on more or less distinct and outwardly directed tubercles, especially when well-matured; flowers hairless, more or less pendulous, pale base of inner side of petals finely spotted with purple except in the Nagamalai specimens where they are transversely striped as in the hairy varieties. Flowering season limited (see above, p. 12).

This variety seems to occur chiefly north-east of the Godavari, having been obtained from Yeleshwaram, Godavari District; Parvatipur, Vizagapatam District; and in the Ganjam District from Barkuda Island in the Chilka Lake and from Berhampur and Gopalpur. There are also, however, specimens from Bargur, Salem District in the Coimbatore herbarium; it has been found in abundance near Agali in the Attapadi Valley, South Malabar; and a few plants have been found on the Nagamalai Hills near Madura, in both of which latter localities it attains a larger size than it does in the north. Especially was this the case with the Nagamalai specimens; but the fact that they were

all growing close to cultivated ground may have been partly responsible for their reaching a height of about $3\frac{1}{2}$ feet. In the Attapadi Valley they reach a height of about $2\frac{1}{2}$ feet and in the north about 2 feet.¹

Var. *fimbriata*, Wallich.

Pl. II fig. 2.

Stems small, not definitely attenuate, sometimes reddish distally, their angles rounded; flowers rather small, more or less pendulous, hairy. Flowering in Madras from about the beginning of the north-east monsoon till well on into the cold weather.

Originally described from Burma (Yenangun and Pagamew), this variety has since been recorded from India and Ceylon (at Ooma Oya, on the lower road from Kandy to Badulla at no great elevation—Thwaites), for the Ceylon plant, though referred somewhat doubtfully to var. *attenuata*, is undoubtedly var. *fimbriata* as Hooker has already suggested. Cook records *fimbriata* from Bopoudi near Poona, but his description cannot possibly apply to the form we know by this name and probably relates to var. *attenuata*, which seems often to have been confused with it. Fr. Blatter has sent us specimens of *fimbriata* from the Satara District (Pasarni Ghat at Panchgani, ca. 3,500 ft. and the rocky banks of the Nira River, ca. 2,500 ft.) We have only found it at Kambakkam, Nagari and Nagalapuram, in the Chingleput District, but we have received plants, which have flowered here, from the Peradeniya Gardens, and presume them to be from indigenous Ceylon stock. The Ceylon specimens have purple flowers very like those of var. *attenuata* in colour but much smaller. The Indian specimens have flowers of a chestnut brown colour and are slightly larger than those of the Ceylon specimens though smaller than those of var. *attenuata*. Wallich's specimens evidently resembled the Ceylon form rather than the Indian one in colour. We do not know whether his figure shows the angles of the stem as rounded or acute. But Berger's reproduction of Loddiges' figure shows them clearly as rounded, and Loddiges refers to the plant as having been introduced by Wallich from Burma.

Var. *attenuata*, Wight.

Pl. I figs. 9-10, pl. II figs. 3-4.

Stems, except when young and undergoing rapid growth, strongly attenuate and usually much branched distally, usually with reddish streaks, their angles always rounded; total height often well over 2 ft., of which only the lower part (less than half this height) is stout; flowers hairy, less definitely pendulous than in the two preceding varieties and often opening more widely when they are about 15 mm. across, their markings usually dark purple in colour. Flowering throughout the year.

This is the most widely distributed of all the varieties of *C. adscendens*. We have found it at Hampi, Hospet and Bellary in the Bellary District; Sidhout near Cuddapah;

¹ These differences in size have been found to persist in specimens of the three forms cultivated in Madras.

Gooty, Penukonda and Madakasira ca. 2,000 ft. in the Anantapur District; Mopad in the Nellore District; Palmaner, Tirupati, Chandragiri and Kalambakkam (Karvetnagar Zamin) in the Chittoor District; Sholinghur in the North Arcot District; Guindy and Nagari in the Chingleput District; Shankaridrug and Battarahalli in the Salem District; foot of Vavumalai, East Pallassana in Palghat taluk; Perumalmalai near Bhavani, Neringipet, Madukarai, Poonachimalai and the lower slopes of the Anamalais in the Coimbatore District; Palni and Dindigul, Madura District; Perungalur and near Nartamalai, Pudukkottai State. There are specimens in the Calcutta herbarium from Kadiri, Anantapur District; Duttalur, Nellore District; Lambton's peak, 2,100 ft., Coimbatore District; and Thirumurti, Palai Valley, 1,300 ft., Anamalai Hills; and in the Coimbatore herbarium from Penchacherla and Kadiri, Anantapur District. It was first described from the foot of the Nilgiris and Hooker quotes Cochin as another locality, but our acceptance of this must be qualified by the fact that *C. stalagmifera* was then unknown and seems often to have been confused with *attenuata* and that other varieties of *adscendens* have also been thus confused. Cook's record of *fimbriata* from Bopoudi near Poona almost certainly, we think, refers to *attenuata*.

Different strains show considerable difference in the length and thickness of the stems and in compactness or diffuseness of growth. These differences seem often to characterise stock from different localities and to persist when the plants are cultivated side by side under uniform conditions.

Plants are sometimes found in which none of the stems are sufficiently mature to have developed their characteristic attenuate and branching distal parts, and may even bear a few flowers in this condition. Such are easily mistaken for var. *fimbriata* but can usually be distinguished by the much greater thickness of their stems.

This form probably hybridizes with the next and possibly (but not probably) also with *C. stalagmifera* (see below, p. 15).

Var. *gracilis*, n. var.

Pl. I fig. 8, pl. II fig. 5.

Anguli caulum acuti; caules supra attenuati, ramulis gracillimis; flores parvi, ciliati, pediculo gracille longo erecto, corolla rotata.

Angles of stems acute; stems green, as much as $\frac{3}{4}$ inch square near base, distally strongly attenuate, very slender and much branched; flowers hairy, widely opened, very small (only about 10 mm. across), erect, borne in pairs on long slender pedicels, their dark markings chestnut brown in colour, the pale expanded portion of the petals larger in proportion to the dark folded portion than in any of the other varieties, and ordinarily with only very faint markings. Maximum height of stems at least 2 ft., of which the last foot or more is extremely slender. Flowering throughout the year.

C. adscendens var. *gracilis* has been found in the Pudukkottai Town forests and at Tiruvarangulam and Tirumayam in Pudukkottai State; at Tiruppattur in the north of the

Ramnad District; at Shankaridrug, Salem District; at Bhavani and Neringipet, Coimbatore District; and at Papanasam and Tenkasi, Tinnevely District. Var. *attenuata* grows in the same localities, except in the Tinnevely and Ramnad districts where it is unknown, and in Pudukkottai where its southerly limit seems to be a few miles north of the former. They seem to hybridize freely with each other to produce intermediate forms in some places but not in all (see above, pp. 11-12). Possible hybrids with *C. stalagmifera* have been obtained from the Pudukkottai Town forests and from Tiruppattur (Ramnad District).

Presumed hybrids with var. *attenuata* (pl. III figs. 5-6).—The angles tend to be less acute than in *gracilis*, especially in the older stems. The flowers, which are never very dark and are of a chestnut brown colour in their darker parts, are rather larger than those of *gracilis* and except in one instance (fig. 6, which might almost be an abnormal specimen of typical *attenuata*), they stand erect, almost always on rather shorter pedicels than in typical *gracilis*. Except in the one pendulous specimen they are always widely opened, rarely a little less so than in *gracilis*, with the basal parts of the petals pale and banded. In other respects these plants resemble both their presumed parents.

Presumed hybrids with *C. stalagmifera* (pl. III figs. 1-4).—Some plants have the angles of the stems acute as in the former, others have them rounded as in the latter. Their stems are very slender distally, though not as markedly so as in vars. *gracilis* or *attenuata*, nor are they branched as in those varieties. Those with rounded angles have only been found at Pudukkottai and might also possibly be hybrids between *C. stalagmifera* and *C. adscendens* var. *attenuata*; but it seems most unlikely that direct crossing between these two forms occurs in view of the fact that nowhere else over the large area in which they occur together have any plants intermediate between them been found. This does not, however, preclude the possibility that the presumed hybrid between *gracilis* and *attenuata* may be able to cross with *stalagmifera* and that in this way intermediates between *stalagmifera* and *attenuata* might arise in the locality where this hybrid occurs. One of the two presumed hybrids with rounded stems (Pl. III fig. 1) has the flowers mounted on such short pedicels, slightly curved downwards, as to suggest the possibility of such an origin for it. Except in this specimen, which differs from the others in no other way, the flowers always stand erect on pedicels at least as long as in *stalagmifera*, but very rarely as long as in *gracilis*. The flowers, which are always dark and of a more or less purplish colour, are about as large as those of *C. stalagmifera*, but have narrower petals with traces of pale bands, or in one case broad coalescent pale bands near the base, and sides with distinct backward fold distally, where they bear long and usually numerous, spindle-shaped hairs. We have also one plant, also presumably a hybrid, which is identical with *C. stalagmifera* in all respects except for the presence of distinct traces of pale bands at the bases of the petals, the sides of which bend backwards distally. These characters may, however, be simply atavistic as is no doubt the former in a specimen showing it from the Simhachalam Hills, where no apparent hybrids are known. The distal portions of the petals of this specimen are moreover of normal *stalagmifera* form.

Var. *carinata*, n. var.

Pl. I fig. 11, pl. II fig. 6.

Anguli caulium acuti; caules supra plus vel minus attenuati, plerumque sine ramulis; flores ciliati, plerumque penduli, pediculo non geniculato.

Angles of stems acute; stems green, distally gradually attenuate in varying degree but never as strongly as in the two preceding varieties, usually unbranched unless the tip is broken and even then with not more than one or two branches, rarely much branched as in var. *attenuata*; flowers purplish, hairy, usually pendulous and campanulate but sometimes semi-erect and rotate, pedicels not bent at an angle. Maximum height a little over 2 feet.

This variety has been found on the Nagamalai and Alagar Hills, Madura District.

Var. *geniculata*, n. var.

Pl. I fig. 7, pl. II figs. 7-8.

Anguli caulium acuti; caules supra vix attenuati, sine ramulis; flores leviter ciliati, pediculo geniculato, corolla rotata.

Angles of stems acute; stems green, usually very slightly attenuate and unbranched distally, sometimes, however, producing a distinctly secondary growth which is very slender and occasionally much branched; flowers hairy but less conspicuously so than in the other hairy varieties, widely opened, about 15 mm. across, facing upwards, their dark markings chestnut brown, the pedicel almost always bent at an angle just below the flower except when, as occasionally happens, it is too short to be bent at all and on slender secondary growths when it seems normally to be erect. Flowering throughout the year. Found on the lower slopes of the Kalakad and Panagudi Hills, Tinnevely District; and at Aramboli and Maruthuamalai, South Travancore.

Caralluma stalagmifera Fischer.

Pl. I fig. 4-6 (see also pl. III).

Caralluma stalagmifera, Fischer, 1925, pp. 430-431, figs. 1-6.

Though less widely distributed than the preceding species, *C. stalagmifera* seems to be quite as widely distributed as var. *attenuata* of that species and much more so than any other of its varieties. *C. stalagmifera* occurs with *C. adscendens* var. *attenuata* over the greater part of its range, but does not seem to extend so far west, though extending north into the area between the limits of the known ranges of that variety and *adscendens*, s. str., and south into the area occupied by the *carinata* group. We have found it in the following places:—Vizagapatam and the neighbouring Simhachalam Hills; Yeleshwaram and the Vemagiri Hills near Rajahmundry, Godavari District; Mochakotta near Tadpatri, Madakasira ca. 2,000 ft. and Penukonda in the Anantapur District; Siddhout in the Cuddapah District; Mopad in the Nellore District; Tirupati, Chandragiri and Kalam-bakkam (Karvetnagar Zamin) in the Chittoor District; Vandalur and Guindy in the

Chingleput District; Pudukkottai (town forests), Tirumayam, Tiruvarangulam and Perungalur, Pudukkottai State; Kanadukathan and Tiruppattur in the Ramnad District; and Dindigul and the Nagamalai Hills in the Madura District.

The colour of the inner surface of the petals may be either chestnut brown as it was, for instance, in the type specimens from Vandalur, or dark purple as it always seems to be in specimens from Guindy. In some localities, such as Pudukkottai and Vizagapatam, the two forms occur together. Sometimes they are spotted with the same colour outside. In only a single specimen from Simbachalam is there any trace of a pale transversely striated area at the base of the petals—a specimen which has the hairs confined to the tips of the petals which are not turned back distally as in the somewhat similar specimens from Pudukkottai and Tiruppattur which have been treated above (p. 15) as possible hybrids, and the stems do not show any long slender distal portion. The stalagmite-like hairs from which the species takes its name may be confined to a very few at the tips of the petals or may form a heavy fringe along the sides of the petals as they do in specimens found together with typical ones at Siddhout and in specimens from the Tirupati Hills, or there may be hairs of this type in the distal parts of the petals and filamentous hairs in the basal parts as in specimens from Kanadukathan. The stems have their angles rounded and are usually more or less streaked with a dull reddish colour—more so even than in *C. adscendens* var. *attenuata*.

This species probably hybridizes occasionally with *C. adscendens* var. *gracilis* and possibly indirectly with var. *attenuata* (see above, pp. 12 & 15).

Subgenus *Boucerosia*, Wight and Arnott.

Type, *Caralluma umbellata*, Haworth.

The greatest difficulty we have encountered in connexion with this subgenus has been the identification of the type species, *B. umbellata*. This species is always described in current literature as having hairless petals, and seems to be regarded as common and widely distributed. We were greatly surprised, therefore, when we failed to find any such form in any of the places where we collected, and we began to suspect that the hairless character attributed to most of the specimens on which the records were based must be the result of the ease with which the hairs disappear in preserved specimens and not of actual hairlessness. An examination of the specimens in the Kew herbarium fully confirmed this, for isolated but otherwise typical hairs were still to be found in specimens labelled *umbellata*, including many of Wight's specimens¹, one of them a large subcampanulate form closely resembling that figured by Roxburgh. It is therefore clear that if *umbellata* is hairless it is not as common and widely distributed as has been supposed. Haworth's type cannot be traced either at Kew or at Oxford, so presumably it no longer exists, and his description gives no clue. Roxburgh's description and figure (1819, pp. 36-37, pl. 241) are therefore the earliest aid we have to assist in deciding the matter. Roxburgh

¹ Wight's description of *umbellata* is "corollae segmentis glabris" (1834, p. 34).

says "Corolla five-parted, smooth" which can scarcely mean anything but hairless, and this conclusion is in agreement with his figure. Of all the various forms we have collected one found on the sacred hill at Tiruvannamalai agrees most closely with this figure. It has the same large sub-campanulate flowers and is practically hairless as well as having, as usual, the same markings. We find, however, every possible gradation between the flowers of this form and the smaller flatter hairy flowers of the form to which the name *lasiantha* is now generally applied. Thus we are forced to conclude that *umbellata* is after all a common and widely distributed species, but that it is usually hairy, rarely practically hairless.

Bouccrosia is a large and unweildy subgenus. Berger (1910, p. 57) divides it into three main divisions, one in which the flowers are in more or less distinct umbels, either terminal or on the ends of short side branches, another in which they arise from the concave sides of the stems, either singly or in small groups, and lastly one which is defined so as to include all other species, especially such as bear their flowers singly either at the tops or bottoms of the stems. All but one (*B. pauciflora*) of the Indian species come into the first of these divisions; and that one must, we find, be included in a group belonging to the first division. The third division, in which Berger places it, is almost certainly a heterogeneous one that will have to be broken up when the affinities of its species come to be better known.

The Indian species fall into three well-marked groups. One contains relatively large forms, the creeping stems of which spread over the surface of the ground, and usually bear numerous erect stems always with their angles acute and flowers terminal. The other two contain smaller forms the stems of which have rounded angles. In one of these the flowers are terminal and the creeping stems spread entirely underground sending up erect loosely branched stems at intervals. These latter stems often die down in hot dry weather to be renewed from the underground stems when more favourable conditions return. In the other group the flowers arise in umbels in the axils of leaves¹ and underground stems are not produced. We think it may ultimately prove to be a convenience to regard these groups as distinct subgenera, in which case the first mentioned will retain the name *Bouccrosia*, Wight and Arnott, *s. str.*, or the name *Eubouccrosia* may be used for it in conformity with *Eucaralluma*, Schumann, while to the group with underground stems the name *Hutchinia*, Wight and Arnott, will have to be applied—*umbellata* forming the type of the former and *indica* the type of the latter. As, however, we have not the material necessary for a complete revision of the genus on these lines, we prefer for the present simply to refer to them as the *umbellata* and *indica* groups respectively. The remaining group we shall refer to as the *tuberculata* group, *B. tuberculata* from the Punjab, etc., being—if our identification is correct (see below, p. 20)—its only known Indian representative. We think that the

¹ It seems likely, from some of the buds that we have seen, that these not infrequently arise in axils so close to the apex of the stem that unless stem growth continues while the flowers develop the latter would appear to be terminal. In the new species, *C. (B.) procumbens*, described below, the reverse process occurs, umbels arising terminally and being displaced by subsequent growth (see below, pp. 26-27).

affinities of this species are likely to be towards species from further west rather than towards either of the groups from the Indian Peninsula.

Berger's second division is distinguished from *Eucaralluma* (*Lalacruma*), as well as from the Indian groups of *Boucerosia*, by the position in which the flowers arise, and is probably we think a natural one; but whether it is susceptible of further subdivision into well-defined groups as we have found his first division to be we have no material to determine.

Boucerosia usually grows in rocky places fully exposed to the sun.

The Indian species of *Boucerosia* may be distinguished from one another as follows:—

1. Flowers arising in axils of leaves; apex of petals produced, narrow, lancet-like. Punjab species ... *C. (B.) tuberculata*, p. 20.
- Flowers terminal¹, apex of petals not produced. Peninsula species ... 2.
2. Plants spreading by long, branching, more or less horizontal underground stems, which terminate above ground in more or less erect and loosely branched stems with rounded angles; small species ... (*indica* group) 3.
- Plants spreading over surface of ground, usually forming dense and extensive clusters of erect and acutely rectangular branches; large species ... (*umbellata* group) 6.
3. Flowers with hairs clubbed, confined to margin between tips of petals; stems about 6 mm. in diameter ... 4.
- Flowers with hairs simple, on surface of petals; stems about 3 mm. in diameter ... 5.
4. External lobes of corona 5, reduced to a broadly truncate top with minute horns or teeth at each end ... *C. (B.) truncato-coronata*, p. 21.
- External lobes of corona 10, of more normal shape ... *C. (B.) crenulata*, p. 21.
5. Petals yellow, transversely striped with purplish, rather broad, their hairs confined to their apical parts; umbels reduced to 1-3 flowers ... *C. (B.) pauciflora*, p. 22.
- Petals uniformly greenish, rather narrow, covered with purplish hair except towards the apex; flowers in larger clusters ... *C. (B.) indica*, p. 23.

¹In *B. procumbens* the buds are terminal; but it often happens that while they are still developing a branch arises from one side of the stem immediately below them, so that by the time the flowers open they no longer occupy a terminal position. Morphologically, however, they are terminal, arising in an entirely different way from those of *C. (B.) tuberculata*.

6. Flowers flattened or subcampanulate, usually more or less hairy throughout, never with hair on margins of petals only; growth normal *C. (B.) umbellata*, p. 23.
- Flowers deeply campanulate, hairless unless on margins of petals 7
7. Growth normal; margins of petals hairy *C. (B.) diffusa*, p. 25.
- Growth continued from immediately below base of umbel, forming long straggling procumbent stems in place of the usual cluster of erect stems; flowers hairless *C. (B.) procumbens*, p. 26.

We have no specimens of *C. (B.) truncato-coronata*, but its position is clearly indicated by the reference in the original description to its size, its succulent "roots" and the nature and position of the hairs on its petals. We think we have plants of *C. (B.) tuberculata*, but they have not flowered so we cannot be certain. We have living specimens of all the other species.

Caralluma (Boucerosia) tuberculata, Brown.

Pl. III fig. 7.

Boucerosia aucheriana, Hooker (nec. Decaisne), 1885, p. 78.

Caralluma tuberculata, Brown, 1892, p. 370.

Caralluma tuberculata, Berger, 1910, p. 83.

Brown describes this species thus.—"Entire plant quite glabrous, $2\frac{1}{2}$ to 6 inches high; stems $\frac{1}{3}$ to $\frac{1}{2}$ inch thick; 4-angled, angles toothed. Flowers crowded into small umbels at the apex of the stems, dark purple-brown, or blackish-purple. Pedicels 1 line long. Sepals, $\frac{3}{4}$ line long, ovate-lanceolate, acute. Corolla 7 lines in diameter, rotate, with a very short campanulate tube, the lobes $2\frac{1}{2}$ to 3 lines long, $1\frac{1}{4}$ to $1\frac{1}{2}$ lines broad, oblong lanceolate, subobtusate with an inflexed apiculus, margins reflexed?, the face covered with small tubercles, the back glabrous and smooth. Outer corona of ten erect subulate teeth, about $\frac{1}{2}$ line long, formed by each of the five lobes being divided almost to the base into two slender teeth. Inner corona of five linear lobes incumbent on the backs of the anthers and not produced beyond them."

Recorded from the Punjab and Baluchistan and as probably from Peshawar and Afghanistan as well. A specimen in the Calcutta herbarium, without flowers but presumably belonging to this species, comes from Cherat, 4,000 ft. Its name is recorded as pawuni in Pushtu and chungu in Punjabi. It bears a note under the name of General Sir H. Collett, dated 1892. "This is sold in the bazaars of Peshawar—and eaten fried with ghee—the juice of the plant [which is very bitter—C. G. Hastings, District Superintendent of Police] having first been expressed."

Caralluma (*Boucerosia*) *truncato-coronata*, Sedgwick.

Boucerosia truncato-coronata, Sedgwick, 1921, pp. 126-127.

Sedgwick describes this species thus.—“*Planta* carnosae, glabra, diffusa, ramis numerosis ad 15 cm. altis. *Radices* crassae, succulentae. *Rami* 6 mm. lati, supra haud attenuati, quadrangulares, faciebus alte sulcatis, et in angulorum tuberculis folia minutissima ovata forentes. *Inflorescentiae* terminales, exacte umbellatae (in exemplo viso), 13 florum. *Bractae* 2½ mm. longae, lineares. *Pedicelli* 1½ mm. longi. *Calyx* ad basim partitus; segmenta 4 mm. longa, linearia, acuta. *Corolla* tuba 6×6 mm. campanulata; limbo in aestivatione 5 segmentis triangularibus, valvatis exacte pentagono et in summo plano, 8½ mm. lato; (segmenta in anthesi utrum erecta sint an patentia haud satis notum, sed, at videatur, erecta); extus viridis, sed in limbo paullo purpureo-maculata, intus purpurea, vel prope nigra, fossiculis numerosissimis, luteis, pellucidis, linearibus, quae in cincturis interruptis dispositae sunt, insignata; inter segmenta in sinibus paucas particulas clavatas ferens. *Androeceum cum gynoecio* parvulum, in corollae basi situm. *Antherae* quadrato-oblongae, obtusae, supra stigmatis discum incurvatae, approximatae sed non contiguae, in dorso sulcatae, colore luteae. *Pollinia* in cellulis solitaria, luteorubra, compressa, erecta, sed latere caudiculis minutis ad translatores erectum purpureum affixa. *Corona* staminalis, duplex, crassa, ut corollae interior pars colorata; lobi exteriores 5, truncati, sed in utroque latere minutissime cornuti; interiores ligulati, elongati, adscendentes et in antherarum dorsales sulcos appressi. *Folliculi* haud visi.

“In arido colle, sub fruticibus diffusa, apud Hubli, District Dharwar, in regione Carnatica Provinciae Bombaiensis, ad alt. 2000 ped. angl., et pluv. 30 digit. angl., mense September, 1919; coll. ipse.

“An inconspicuous plant with elegant flowers. Differs from the other Indian species in having the bifid corona lobes reduced to a broadly truncate top with minute horns or teeth at each end.”

Caralluma (*Boucerosia*) *crenulata*, Wallich.

Pl. III figs. 12 13.

Caralluma crenulata, Wallich, 1830, pp. 7-8, pl. vii-viii.

Caralluma crenulata, Berger, 1910, pp. 89-90.

This species is evidently related most closely to *C. truncato-coronata*, of which we have not seen specimens and with which we cannot, consequently, compare it in detail. As compared with the species with which we are familiar its most distinctive characters are found in the clubbed hairs on the margins of the bases of the free portions of the petals, the cup-shaped centre and flattened outer parts of the flowers, and the white or yellowish ground colour with purple spots of the corona. Matured buds are flat above. The outer lobes of the corona are small, with the members of adjacent pairs about as widely separated from each other as they are from the inner lobes on either side of them. The inner corona lobes are usually pointed and often more or less trifid. The colour of the

petals is rich brown and clear yellow arranged in broken but concentric streaks, the brown usually, but not always, predominating. There is usually a well-marked circle of yellow where the central cup joins the flattened portion of the flower. The free parts of the petals sometimes tend to bend upwards, particularly in preserved specimens. In Madras flowers are only produced during and shortly after the heavy rains of the north-east monsoon in about November. The stems have their angles rounded, are about 6 mm. in diameter and may attain a height of about 12 to 15 cms. but are commonly shorter than this.

First described from Segain (opposite Ava) on the Irrawady, it has since been recorded from the Shan Plateau (Berger). There is also a specimen in the Calcutta herbarium from Minbu on the Irrawady. Our plants came from the Calcutta Botanical Gardens.

Caralluma (Boucerosia) pauciflora, Wight.

Pl. III figs. 14-17.

Boucerosia pauciflora, Wight, 1834, pl. opposite p. 34.

Boucerosia pauciflora, Decaisne, 1844, p. 648.

Caralluma pauciflora, Berger, 1910, p. 112, fig. 18, 6-7 (p. 84).

Caralluma pauciflora, Gamble, 1923, p. 862.

The cup-shaped flowers borne singly, or at most in twos or threes, in place of the usual umbel, at once distinguish this species from other Indian ones. Mature buds are conical above with the apex of the cone slightly elevated (fig. 15). The flowers are rather pale, with the usual concentric purplish markings strongest towards the centre. Hairs are present all over the free distal parts of the petals, but are absent nearer the base. The outer corona lobes are whitish with purple tips and are arranged as usual in pairs between the inner ones, which are more or less whitish distally. In Wight's figure the former are nowhere in contact and the latter are rounded distally. In our specimens the latter are truncate (rectangular) distally and the former, though separated at their bases, invariably bend round so that their apices are in contact. In view of the apparent constancy of many such small characters in particular strains among other species this difference is not likely to be important. It is, however, possible that it may indicate the existence of two local races, for Wight's specimens—including presumably those from which his figures were made—were from Palamcottah in the Tinnevely District, whereas ours are from Pudukkottai, Tirumayam and Tiruvarangulam in Pudukkottai State, and from the Nagamalai and Alagar Hills in the Madura District. No other records seem to have been made. Flowers appear only during the rains of the north-east monsoon.

The stems are about 3 mm. broad. In Madras they never seem to grow more than about 6 cm. high, the plants always having a somewhat stunted appearance. In Pudukkottai, however, they grow more luxuriantly, closely resembling those of *C. (B) indica*. Wight's figure of the flowering plant is about twice the natural size.

Caralluma (*Boucerosia*) *indica*, Wight and Arnott.

Pl. III figs. 8-II.

Hutchinia indica, Wight and Arnott, 1834, pp. 34-35.*Hutchinia indica*, Wight, 1842, p. 4, pl. 355.*Caralluma indica*, Berger, 1910, p. 83, fig. 18, 1-2.*Caralluma indica*, Gamble, 1923, p. 862.

The dark purple hairs of this species contrast strongly with the light green petals, which are narrower and more sharply pointed than in either of the two preceding species and are more or less completely without hair at their tips. The matured buds are conical above, with the apex of the core slightly depressed (fig. 9). The outer lobes of the corona are erect, light yellowish, sometimes with the extreme tip purplish. The inner lobes of the corona are not unlike those of *C. (B) pauciflora* but are more yellowish at the tip. Adjacent lobes have a deep cleft between them, usually (but not always) with a minute yellowish tooth projecting into it. They have never been seen so united with this tooth and one another as to form a single trifid lobe as shown in Wight's figure. In this figure, too, as in his figure of *C. fimbriata* (see above, p. 9), the angles of the stems are made so prominent as to appear strongly acute, instead of rounded as they actually are. The stems are of about the same thickness as in *C. (B) pauciflora*, but longer and slenderer. They rarely, if ever, rise erect to a height of more than about 10 cm. but may be longer when parts are more or less procumbent. The smell of this species is unlike that of any other known to us, resembling that of fungus rather than that of carion. It seems to attract small ants, not flies. We have specimens from Guindy and Nagalapuram in the Chingleput District, and probably from near Katpadi in N. Arcot and Mopad in the Nellore District, but these two have not flowered. Gamble records it from Nellore and S. Arcot. It flowers only in the north-east monsoon.

Caralluma (*Boucerosia*) *umbellata*, Haworth.

Pl. IV figs. 1-9.

Caralluma umbellata, Haworth, 1812, p. 47.*Stapelia umbellata*, Roxburgh, 1819, pp. 36-37, pl. 241.*Boucerosia umbellata*, Wight, 1842, pl. 495.*Boucerosia umbellata*, Decaisne, 1844, p. 648.*Boucerosia lasiantha* + *campanulata*, Wight, 1850, pl. 1286-1287.*Boucerosia umbellata*, Thwaites, 1864, p. 200.*Caralluma campanulata*, Hooker, 1893, pl. 7274.*Caralluma umbellata* + *campanulata* + *lasiantha*, Berger, 1910, pp. 67-70, figs. 12, 1-6 and 18, 3-5.*Caralluma umbellata* + *campanulata* + *lasiantha*, Gamble, 1923, pp. 861-862.

It seems to us, as already pointed out above (pp. 17-18), that this is an extremely variable species and that it must be so defined as to include forms with hairy flowers as well as those in which they are hairless. This must now be explained in further detail.

The commonest form is the one with comparatively small, flattened and very hairy flowers, to which the name *lasiantha* is generally applied. It is variable in colour, the

relative amounts of the yellowish ground and the purplish streaks differing greatly in different specimens, plants the flowers of which contrast strongly with one another in this respect often growing within a few yards of one another. We have never seen any plants in which the dark streaks are absent, but we have met with two, one from Madakasira in the Anantapur District and the other probably from near Bangalore, in which no trace of the ground colour remains, the flower being of a uniform rich deep purplish brown throughout. The intensity of the dark colour often varies likewise, fading somewhat after the flower has been open for a day and being commonly less when it is less in extent than when it is more. In many flowers the dark streaks, if examined with a lens, are found to be thickly covered with minute tubercles, many of which are elongated into hairs varying from quite minute to a millimetre or more in length. The longer ones swing freely from their bases and are readily shed, which the shorter ones naturally are not; but there does not appear to be any sharp fundamental distinction between them. In other flowers the dark streaks are smoother, and though they usually—perhaps always in the small flattened type of flower—bear long hairs which are easily shed, there may be few if any shorter ones to indicate the essential unity of these with the minute tubercles from among which they arise. Near Battarahalli in the Salem District one of us had the good fortune to find a number of specimens in flower together. Most of these were of the large subcampanulate type figured by Roxburgh, but covered with hair, mostly rather short. With them were, however, others that were smaller and flatter, resembling typical *lasiantha* in all points except the hair which, as in the larger flowers, was mostly rather short. Large, subcampanulate and at first sight apparently hairless flowers have been collected at Tiruvannamalai and Pudukkottai, in company with hairy ones. These apparently hairless flowers are all paler in colour (after preservation in formalin) than are the Battarahalli flowers and do not seem to bear the dense coat of short hairs that is shown by the latter, though some such hairs can be seen near the centre with the aid of a lens and were well marked in fresh material obtained from an otherwise hairless Pudukkottai plant that flowered in Madras. As the long hairs are altogether absent, the flowers appear hairless to the naked eye. We therefore find it impossible to draw any hard and fast line between *umbellata* and *lasiantha*. Typical hairless *umbellata* is so much rarer than the transitional forms that we cannot reasonably regard it even as a really distinct variety between which and the commoner hairy forms the transitional ones might otherwise have been hybrids; nor can it apparently be regarded as a geographical race. Consequently, the name *lasiantha* must be sunk as a synonym of *umbellata* and the latter defined so as to embrace the forms hitherto known by the former name.

On the same grounds we believe that *campanulata* should also be regarded as a synonym. There is nothing either in the original description and figure by Wight or the later ones by Hooker to separate it from *umbellata*, unless it be the combination of its uniformly dark colour with Wight's description of the corolla tube as "glabrous on both sides". We should certainly have expected any such dark form to have been finely and

densely pilose within, even in the absence of long hairs. As, however, Wight "received the specimens without the station being marked" they cannot have been fresh, and any such pilosity might readily have been overlooked, as it may also have been by Hooker, who gives no fresh description at all. But even if renewed examination of these types should prove the corolla to be absolutely smooth we should still feel that this additional variation, though not quite on the lines we have actually observed, was too small a departure from them to be likely to have any greater taxonomic value than other characters which, for reasons already given, we have been compelled to disregard in dealing with the present species.

The shape of the buds varies somewhat in accordance with the shape of the flower, but they are always much more flattened both above and below than in *C. (B.) diffusa*. The size, colour and hairiness of the flower are very variable as already described, and large flowers are as a rule distinctly subcampanulate while small ones are flattened. The outer corona, though constant in its general form, varies in detail within fairly wide limits, as indicated in plate iv figs. 7-9 which show the widest range of variation we have observed. The lobes of the inner corona are as a rule thickened behind at the base. Often these thickenings are of so definite a form as to suggest that they are processes from the outer corona that have come to be fused to the backs of the lobes of the inner corona. The angles of the stems are acute, sometimes produced into a series of more or less distinct teeth, sometimes not.

C. (B.) umbellata flowers mostly from about February or March till about July or August.

We have found this species at Madakasira, ca. 2,000 ft., and Gooty in Anantapur District; Horselykonda and Tirupati in Chittoor District; Kambakam and Nagalapuram in Chingleput District; Katpadi and Tiruvannamalai in North Arcot District; Battarahalli and Sankaridrug in Salem District; near Agali, Attapadi Valley, South Malabar; also specimens, almost certainly of this species but with buds not quite fully developed from Aramboli, South Travancore and from Pudukkottai. There is a specimen from Palmaner in the Chittoor District in the Calcutta herbarium. And there are specimens in the Coimbatore herbarium from Gingee Hills; Bargur, Salem District; Maddur Road, Bhimanbidu, Mysore; Nagari, North Arcot District; Vepurkota, Cuddapah District; and Adakkam, Palni Hills. The type of *lasiantha* came from the Nagari Hills, whence we have obtained plants that probably belong to this species but have not yet flowered; it has also been recorded from Pondicherry (Decaisne) and from rocks near Kornegalle in Ceylon (Thwaites).

Caralluma (Boucerosia) diffusa, Wight.

Pl. IV figs. 10-12.

Boucerosia diffusa, Wight, 1850, pl. 1599.

Caralluma diffusa, Berger, 1910, pp. 68-69, fig. 12, 5-6.

This is a much less abundant species than *C. (B.) umbellata* and we have not as yet noticed any marked colour variation in it. We have, however, one strain which differs

from the typical form in having thinner stems, smaller umbels (not more than about a dozen flowers) and narrower and more acutely pointed petals, the matured buds being consequently more acutely conical above. Unfortunately we have no clue to the original habitat of this form, which we first saw cultivated as a rock plant in a Madras garden. The only place where we have found *C. (B.) diffusa* growing wild is on the sacred hill at Tiruvannamalai where it is not uncommon and was found flowering in October, 1926, but we also have plants which probably came from near Bangalore. The type came from "arid rocky mountains near Coimbatore, at an elevation of about 2,000 feet, flowering April and May." In Madras our plants flower occasionally in April and May and again from August to about November.

The flower is deeply campanulate with deeply divided petals, matured buds always being conical above. The surface of the petals is hairless, but the dark streaks are minutely papillose though somewhat less so than in *C. (B.) umbellata*. There are a number of long and easily detached hairs on the margins in all specimens that have yet been recorded. The outer lobes of the corona are more closely in contact at their base with each other than with the inner lobes which are somewhat variable in shape. The stems closely resemble those of *C. (B.) umbellata* but never attain the size of those of the larger strains of that species.

Caralluma (Boucerosia) procumbens, n. sp.

Pl. IV figs. 13-17.

Caules elongati, procumbentes, angulis acutis; flores campanulati, glabri.

This remarkable species was recently discovered by the junior author growing in crevices among rocks at Maruthuamalai in South Travancore. Plants were also found at Aramboli, South Travancore, but no flowers were seen there. It differs from all other Indian species in its manner of growth and might well be regarded as the type of a fourth group if it did not stand alone in this respect. Morphologically it is so closely allied to the *umbellata* group that it can easily be included within it.

The stems, which are about 15 mm. broad, resemble those of the *umbellata* group in the acuteness of their angles and in not, so far as we know, producing any underground branches; but instead of forming more or less compact clusters of upright branches they remain procumbent, branching little, trailing over rocks, and rooting where opportunity occurs. They may reach a length of over six feet. The protuberances marking the positions of the leaf scars are very indistinctly indicated.

The flowers are slightly smaller than those of *C. (B.) diffusa* and about equally strongly campanulate, but much thicker and firmer and entirely without hairs. They arise terminally in small umbels; but the stem commonly sends out a side shoot from the axil of a leaf immediately below and this grows so as to push the umbel rather to one side. The result is that the flowers of this species and of the northern species we believe to be *C. (B.) tuberculata* come to occupy very similar positions, though arising in quite

different ways. The stems and manner of growth of the two plants are of course also quite different. The ground colour of the petals is whitish and the streaks are purple. A few purple dots are often found on the outer sides of the petals in addition to the streaks on the inner sides. The corona (pl. iv fig. 17) is whitish, mottled with a pale purplish colour.

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PLATE I.

- Fig. 1. *Caralluma edulis* (from Edgeworth).
 „ 2. *Do.* Corolla opened out (from Edgeworth).
 „ 3. *Do.* Part of corona opened out (from Edgeworth).
 „ 4. *Caralluma stalagnifera* with flower $\times 1$.
 „ 5. *Do.* flower $\times 2$.
 „ 6. *Do.* with seed pod.
 „ 7. *Caralluma adscendens*, var. *geniculata*, flower $\times 2$.
 „ 8. *Do.* *gracilis*, flower $\times 2$.
 „ 9. *Do.* *attenuata*, rotate type of flower $\times 2$.
 „ 10. *Do.* *do.* dark rotate variety of flower $\times 2$.
 „ 11. *Do.* *carinata*, rotate and dark coloured type of flower $\times 2$.



PLATE II.

Fig. 1. *Caralluma adscendens*, s. str. $\times 1$.

„ 2. *Do.* var. *fimbriata* $\times 1$.

„ 3. *Do.* do. *attenuata* $\times 1$

„ 4. *Do.* do. do. *corona* $\times 4$.

„ 5. *Do.* do. *gracilis* $\times 1$.

„ 6. *Do.* do. *carinata* $\times 1$.

„ 7. *Do.* do. *geniculata* $\times 1$.

„ 8. *Do.* do. do. flower with pedicel $\times 2$.



PLATE III.

- Fig. 1. Presumed hybrid between a form such as is shown in fig. 6 and *C. stalagmifera* × 1.
- „ 2-4. Presumed hybrids between *C. adscendens* var. *gracilis* and *C. stalagmifera* × 1.
- „ 5-6. Presumed hybrids between *C. adscendens* vars. *gracilis* and *attenuata* × 1.
- „ 7. Stem of (?) *Caralluma* (*Boucerosia*) *tuberculata*, showing at A an umbel bud in axil of leaf × 1.
- „ 8. *Caralluma* (*Boucerosia*) *indica* × 1.
- „ 9. Do. Bud × 1.
- „ 10. Do. Flower × 2.
- „ 11. Do. Corona × 4.
- „ 12. *Caralluma* (*Boucerosia*) *crenulata*. Flower × 1.
- „ 13. Do. Corona × 4.
- „ 14. *Caralluma* (*Boucerosia*) *paniciflora*. Flowers × 1.
- „ 15. Do. Buds × 1.
- „ 16. Do. Corona × 4.
- „ 17. Do. Part of corona seen from the side.

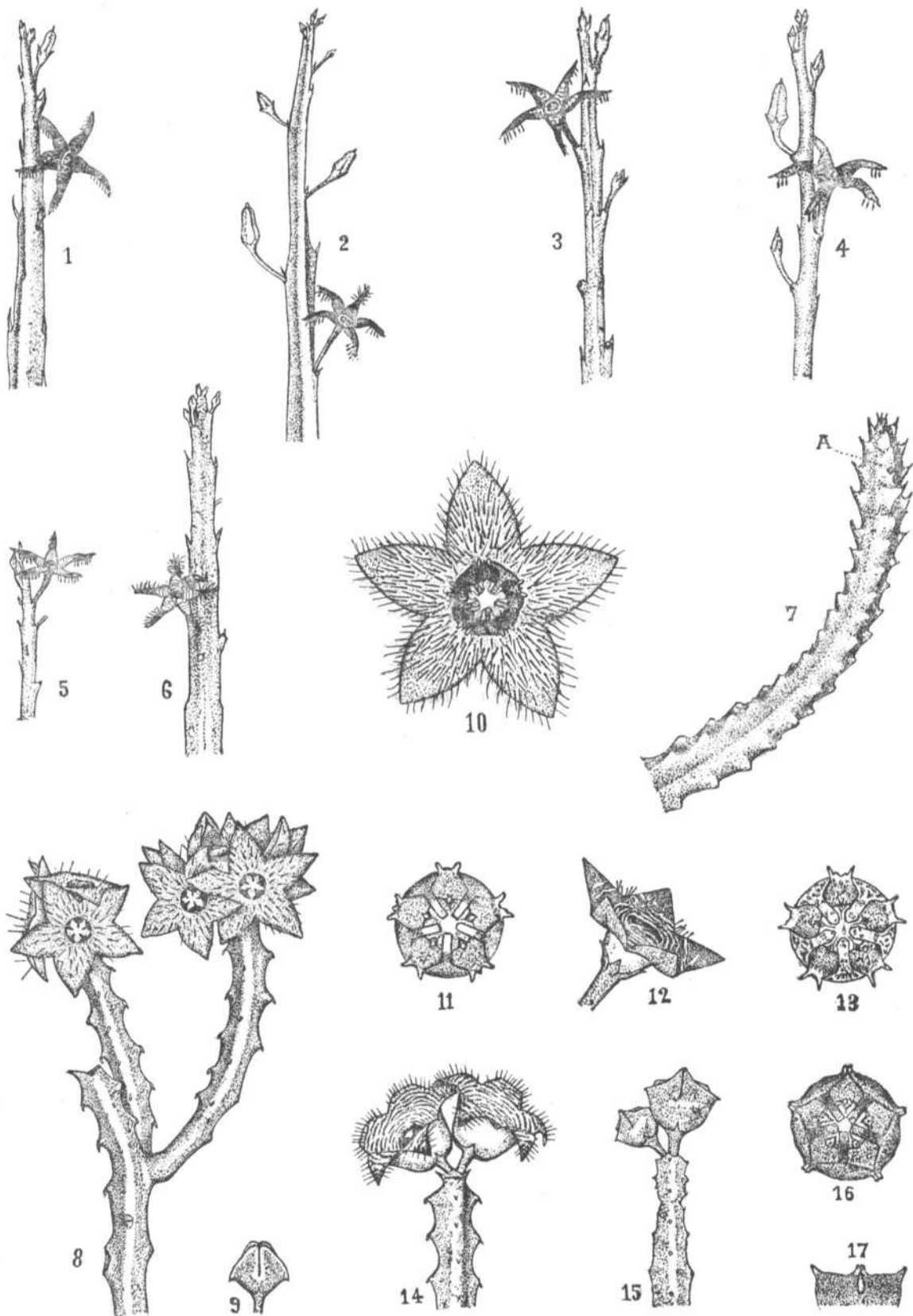


PLATE IV.

- Fig. 1-6. *Caralluma (Boucerosia) umbellata*. Flowers $\times 1$, showing variation.
 „ 7-9. Do. Corona $\times 4$, showing variation.
 „ 10. *Caralluma (Boucerosia) diffusa*. Flower $\times 1$.
 „ 11. Do. Umbel $\times 1$.
 „ 12. Do. Corona $\times 4$.
 „ 13. *Caralluma (Boucerosia) procumbens* $\times 1$, showing habit.
 „ 14. Do. Flower $\times 1$.
 „ 15. Do. Bud $\times 1$.
 „ 16. Do. Inner side of petal $\times 2$.
 „ 17. Do. Corona $\times 6$.

